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Maine Agricultural Experiment Station

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POTATO INSECTICIDES AND FUNGICIDES IN 1902.

OAT SMUT AND ITS PREVENTION.

This Bulletin contains notes upon the more common insecticides sold in Maine in 1902; upon the use of Bordeaux mixture in 1902; the results of field experiments with potatoes, comparing Paris green, Bug Death and arsenate of lead; and also a description of oat smut and its treatment.

Requests for bulletins should be addressed to the
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Orono, Maine.

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ORONO, MAINE.

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NOTES ON AND EXPERIMENTS WITH INSECTICIDES AND FUNGICIDES IN 1902.

CHAS. D. WOODS.

The year 1902 was not characterized by special abundance of the Colorado potato beetle. Early in the season there were only a few old beetles to be seen on most fields and compared with some years little damage was done by the potato bug even upon potatoes that were inadequately protected. The damage from the flea beetles was not any above and perhaps below that of average years. The insecticides used in the State were practically the same as in past years, Paris green taking the lead. Considerable quantities of arsenate of lead and Bug Death were used.

PARIS GREEN.

Pure Paris green is aceto-arsenite of copper and should carry 58.65 per cent of arsenic. The arsenite of copper with 52.94 per cent of arsenic is sometimes sold under the name of Paris green. As made commercially, there is practically no Paris green which is a strictly aceto-arsenite of copper. Since arsenious oxide (white arsenic) is the cheapest single constituent that enters into the manufacture of Paris green, it follows that the manufacturer will usually endeavor to use as much white arsenic as is consistent with making a good green. Forty-five samples of Paris green have been recently examined by the Bureau of Chemistry of the U. S. Department of Agriculture. The total arsenic (arsenious oxide) ranged from 56.2 to 61.2 per cent and the copper (copper oxide) varied from 28.5 to 31.2 per cent. These analyses confirmed our own observation that there are practically no Paris greens on the market deficient in arsenic.

Since Paris green has begun to be used as an insecticide it has been a familiar experience that sometimes it burns the foliage. The reasons for this have been quite carefully investigated and it has apparently been found that this scorching of the foliage is due to the water soluble arsenic in the goods. In the Paris green examined by the U. S. Department of Agriculture, the water soluble arsenic (arsenious oxide) varied from 2.7 to 10.5 per cent. With four exceptions there was less than six per cent of water soluble arsenic in the samples examined.

The green made by the C. T. Reynolds Company, which is very largely used in Maine, was found by the Department to carry the highest per cent of water soluble arsenic. A sample of Reynolds green examined at this Station was found to carry 7.49 per cent of arsenic soluble in water. The amount of water soluble arsenic in the Paris green is of considerable importance. In many states there are laws limiting the amount of arsenious oxide which is allowable in Paris green. In California and in Massachusetts and other eastern states, 4 per cent is the limit. In Idaho 6 per cent has been adopted as the maximum amount.

As has been pointed out in other publications of the Station, much of the harm of the soluble arsenious oxide in Paris green can be overcome by mixing it with lime water. To be most effectual, it should be mixed with the lime water several days before it is to be used and the mixture occasionally stirred, as the water soluble arsenious oxide goes into solution very slowly.

If samples of green, particularly in the original package, are sent to the Station they will receive as prompt analysis, free of charge, as is consistent with our other work. The time involved in an analysis is considerable and it is not always possible to take up the work immediately on receipt of sample.

ARSENATE OF LEAD.

Arsenate of lead is made by the Merrimac Chemical Company and the Bowker Chemical Company, both of Boston. The Bowker Company sell their output under the name of Disparene. As sold they both carry considerable water, which seems to be necessary in order to make them go readily into suspension in water. They carry from 50 to 60 per cent of actual arsenate of lead, which gives them from 13 to 15 per cent of arsenious oxide. Hence it would take nearly four pounds of arsenate of lead as found in the market to furnish as much arsenious oxide as a pound of Paris green. The arsenate of lead is but very slightly soluble in water and on this account is safer for foliage than is Paris green. In our experiments arsenate of lead was not used with as good results in 1902 as in the two preceding seasons.

OTHER ARSENICAL COMPOUNDS.

The arsenoids, London purple, Paragrene, etc., have been used in the State only to a very limited extent. Any one interested will find these discussed in Bulletin 68 of this Station.

Insecticides Carrying a Small Percentage of Arsenic.

There are a number of insecticides in the market, some of which purport to be better than Paris green, all of which are dependent upon arsenic in some form for whatever value they possess as insecticide. These materials practically consist of Paris green mixed with gypsum, coal dust, or something of that kind, and are for all practical purposes simply badly adulterated Paris green. Their cost is considerably less than that of a pure green, but the poison they contain costs the consumer from five to ten times as much as it would if he were to buy a good green and mix it with the diluents.

BLACK DEATH, QUICK DEATH, ENGLISH BUG COMPOUND.

Black Death has been quite extensively advertised in this State and probably has been more or less used. Its analysis shows it to be Paris green diluted with gypsum to make weight, and colored with charcoal or coal dust. According to the analysis of the U. S. Department of Agriculture it carries about 1.75 per cent of Paris green; the other constituents being chiefly gypsum and carbon. It follows, therefore, that it would take more than fifty pounds of Black Death to equal one pound of Paris green as an insecticide.

Quick Death, made by the American Insecticide Company, Binghamton, N. Y., in appearance and composition resembles Black Death and is stated by those who should know to be Black Death under another name.

English Bug Compound has not been heard of very much lately. A sample examined a few years ago consisted of white arsenic diluted with gypsum.

KNO-BUG.

Kno-bug is a reddish brown powder made by the Carpenter-Morton Company of Boston, which, according to the claim of the makers in 1902, destroys potato bugs, acts as a vegetable tonic, stimulates the growth of the plant, and prevents blight, scab and rust.

The material is found to contain several things, of which Paris green is the poison, nitrate of potash the plant food, and carbonate of copper the germicide.

Analysis of the material shows it to have substantially the following composition:

Calcium sulphate (land plaster),	88.0 per cent.
Iron ochre,	2.0 per cent.
Nitrate of potash,	4.5 per cent.
Paris green,	2.5 per cent.
Carbonate of copper,	2.0 per cent.
Water and undetermined,	1.0 per cent.

The Paris green in these goods is the only thing of much value to the potato grower. The plaster and nitrate of potash contain plant food, but the benefit to be obtained from small applications above ground is inconsiderable.

The goods sell according to the advertisements at prices ranging from five to ten cents per pound, according to the size of the package. Its high cost comes chiefly from the fact that it is put up in small packages. A mixture of Paris green and plaster which will equal Kno-bug as an insecticide can be made by the farmer for very much less cost.

In a newspaper bulletin issued last June by the Station, Kno-bug was called a fraud. It was so called because it claimed to be better than Paris green and safer to use as an insecticide, when it depended upon Paris green for its value as an insecticide; because it claimed to prevent blight, for which carbonate of copper is not a specific; and because it was claimed to prevent scab, which cannot be done by any treatment of vines. The manufacturers, Carpenter-Morton Company, Boston, state that they acted in good faith and had no intention of fraud in putting the goods on the market, and that chemists in whom they had confidence advised them that its ingredients would produce the results claimed. The coming season they intend to make no claim for Kno-bug as a fungicide, and will base their reasons for its sale upon its merits as an insecticide.

A field test of Kno-bug was made by the Station in 1902 chiefly to ascertain if it had value as a fungicide. The first application was made when the potatoes were about a foot high. This piece had been previously sprayed with Bordeaux mixture and arsenate of lead. No further application of Bordeaux mixture was made to this plot. The adjoining plots were sprayed four more times with Bordeaux mixture and a poison. The yield was much less on the plot to which Kno-Bug was applied and the percentage of rot was very much increased. The vines died three weeks earlier than on the plots treated with Bordeaux mixture.

In this test Kno-bug was practically valueless as a fungicide. The diminished yield was due to blight and not to injury from insects. Applied in sufficient quantity, the Paris green contained in Kno-bug will kill the bugs.

HAMMOND'S SLUG SHOT.

Hammond slug shot carries sulphur, carbolic acid, Paris green, and tobacco, mixed with gypsum. The manufacturers claim it to carry only one per cent of arsenic. A sample examined by the U. S. Department of Agriculture carried 1.58 per cent of arsenic in the form of Paris green.

Insecticides Not Containing Arsenic.

BUG DEATH.

Bug Death, made by the Danforth Chemical Company, Leominster, Mass., is unique in being, so far as has come to the writer's attention, the only insecticide which does not depend upon arsenic for its effectiveness. It is practically impure zinc oxide. It carries more or less of iron and lead oxide and small amounts of silica, chlorine, potash and phosphoric acid. These latter constituents are apparently accidental and vary somewhat within narrow limits. When the goods were first placed upon the market, their mechanical condition was very different from what it is at present. In 1900 the Experiment Station used it in the field at Houlton and also in a green house test. The Bug Death killed some of the beetles and slugs and drove the majority of the others from the plants. Many of them went into a stupor lasting from 12 to 36 hours and then revived and were apparently as well as ever. The goods used that year were coarsely ground, feeling gritty to the touch and could not have been sprayed successfully, as they would have clogged a Vermorel nozzle. The Bug Death used by the Station in the season of 1902 was ground to an impalpable powder and even at the rate of 40 pounds to the barrel was sprayed through a Vermorel nozzle without any difficulty. One enthusiastic user of Bug Death in Maine believes it to be exceedingly valuable as a means of ridding cucumber and squash vines of the striped bug. It will be thoroughly tested by the Station the coming season on the melon family, and if it should prove efficient it will be very valuable, because thus far we have no adequate remedy for the striped beetle.

In 1900 Bug Death was used by us in the dry form; in 1902 it was used by us in connection with Bordeaux mixture and applied by spraying. The full account of this experiment is given on pages and, as will be there noted, at the rate of 62½ to 125 pounds per acre, in five applications, it was efficient as an insecticide. The following is the summary of the results of experiments in 1900 as given in Bulletin 68 of this Station.

1. As an insecticide, at the rate of 100 pounds per acre, it freed from bugs; at the rate of 40 pounds per acre it had no appreciable effect.

2. As a fungicide; blight did not appear so soon or so badly when Bug Death was applied, in three applications, at the rate of 180 pounds per acre, as on untreated vines.

3. Effect on foliage; at the rate of 40 pounds per acre, no appreciable effect; at the rate of 100 pounds per acre, some of the leaves curled on the edges and finally died.

4. Fertilizer; as its only fertilizer constituent is a little potash with a trace of phosphoric acid, it was not tested as a source of plant food.

5. Its economy; because of its high cost and slow application, no one growing any considerable amount of potatoes can afford to use Bug Death.

The results of the experiments described on page seem to warrant a modification of conclusions 1 and 5 so that they will read as follows:

1. As an insecticide. Applied in a fine spray at the rate of 15 pounds per acre at each application, it will free the potato vines from bugs well enough for practical purposes; and at the rate of 25 pounds, it is thoroughly efficient as a remedy against the potato bug.

5. Applied with Bordeaux mixture, it can be as cheaply and as easily applied as Paris green or arsenate of lead. The experiments by Mr. Rogers and the Danforth Chemical Company

seem to indicate a sufficiently increased yield to pay its cost ($5 to $7). These results are *not* confirmed by the Station experiments.

NOTES ON FUNGICIDES.

The year 1902 is the first year in which potato blight has been particularly bad since the Station began experiments in the great potato growing section of this State. In 1901 there was a large acreage with some blight and rot on unsprayed fields. In that season sprayed potatoes, even though treated only once or twice were free from blight and rot. Unfortunately this apparent help from imperfect protection led many to believe that the four to six sprayings urged by the Station were unnecessary and that two sprayings were equally good. In 1902, even in the case in which the spraying has been quite thorough, the results have been disappointing, as the protection has been only partial. For example: In the Experiment Station experiments with insecticides there was found on fairly drained ground a loss of 10 per cent due to rot, and on poorly drained ground the loss was much greater. One large grower recently at the Station was much discouraged at the outlook; he said he sprayed three times and fully half of his potatoes rotted. However, it came out in the course of the conversation that a piece which he sprayed twice rotted so badly that he did not dig them. Thus the extra spraying gave him one-half of a crop and it is probable that if he had sprayed twice more his loss from rot would have been no greater than in the Station experiments. The blight progressed peculiarly the present season. For the most part potatoes were late planted and through July and August made very rapid growth, much of the time an inch a day. This soft, succulent foliage was apparently peculiarly susceptible to the blight. Blight, however, did not appear until late, so that in most instances the tops were covering the ground and forming a dense mat at the time in which it appeared and most pieces had not been sprayed for some little time previous for fear of injuring the tops by driving through the field. The blight progressed somewhat slowly but still made decided progress at lower temperatures than has usually been supposed to be favorable to its growth. While pieces quite thoroughly treated have not been perfectly free from rot, the season has added to the importance of thorough spraying as a protection against blight and the subsequent rot. The fact that pieces planted on land not well drained and on farm manure suffered worse from rot than where the conditions were different, points out the necessity for careful selection of potato land. The ill effects of farm manure seem to indicate that the fungus which produces the rot may be distributed through the soil as well as through the tops. This is in accord with observations made before Bordeaux mixture was used and confirms the soundness of the usual practice of planting on turf land with commercial fertilizers.

Ready made Bordeaux mixtures were not used in experiments in the Station this year. In former years they gave fairly satisfactory results. Some users in 1902 are not as well satisfied as though they had used the regular home made mixture. This can probably be explained by the fact that if they had used the ready made goods in accordance with directions which come with them, they were only about one-half the strength of the home made goods.

EXPERIMENTS WITH PARIS GREEN, BUG DEATH AND ARSENATE OF LEAD.

In the season of 1901 some users of Bug Death were satisfied that they got a larger yield of potatoes where Bug Death was used as an insecticide in conjunction with Bordeaux mixture than where Paris green was used also with Bordeaux mixture. Many articles were written for the agricultural press condemning the use of Paris green on the ground that it injured the foliage, thus stopping growth, and one writer made the claim that the tubers themselves contained arsenic when Paris green was used for killing bugs. Therefore, an experiment was undertaken to compare arsenical poisons with Bug Death, with the view of ascertaining whether arsenic in the form of Paris green or arsenate of lead injures the growth of the potato vines so as to affect the quantity or the quality of the tubers.

Field experiments at best are apt to be unsatisfactory because of lack of uniformity of soil and stand of the crop. In order to avoid the former the experiment was arranged alternately in ribbon strips, so the number of plots might reduce the inequalities of soil as far as possible. The chief difficulty of the experiments in 1902 was missing hills. The field which at planting was intended for this experiment was not used because of the number of missing hills. A field was finally selected on which the stand was fairly uniform. The land had been uniformly manured the preceding year and had grown potatoes and the yield of 1901 was fairly uniform over the whole field, being somewhat smaller on the north side, the yield gradually increasing to the south. Eight rows running across the field, so as to include nearly one half acre, was selected for each plot. At harvest the two outer rows of each plot were rejected and 14 rods of the west end of 6 rows were used for the comparative yields. The potatoes from these pieces were assorted and weighed in the field. All of the details of the experiment were under the personal supervision of the director or Mr. Bartlett, chemist to the Station. Twice at the time of taking notes representatives of the Danforth Chemical Company and of the Merrimac Chemical Company were present and their judgment agreed with the notes taken.

The amounts of Bug Death used per acre were those suggested by Mr. Merrill, the superintendent of the Danforth Chemical Company. The field was sprayed five times, July 12, July 19, July 26, August 2, and August 27. Bordeaux mixture was used at each application at the rate of a barrel to the acre. The Paris green and arsenate of lead were used only in the four first applications. Bug Death, at the request of Mr. Merrill, was used in all five applications. The arrangement of plots and yields are given in the table on page . The rows ran east and west, plot one being on the north side.

FIELD NOTES.

Plots were all sprayed July 12.

July 15 there were very few eggs on the pieces and no slugs had hatched. The plants had formed two or three leaves since they were sprayed the 12th.

July 19 plots all sprayed.

July 22 slugs just beginning to hatch and practically no slugs of any size on the entire field. The notes for the individual plots were practically all alike. Occasional plants over the piece had a few newly hatched slugs on the terminal leaves.

July 26, all plots sprayed.

July 27. Plot 1. Few small slugs on occasional plants. Plot 2. Quite free from bugs, but rather more than on plot 1. Practically no large slugs. Plot 3. Rather more slugs than on plot 2, particularly on the south side of the plot. Plot 4. Some slugs, rather less than on plot 1 and small. Plot 5. About the same as plot 4. Very few slugs. Plot 6. Had no slugs; all smaller than on plot 5; vines somewhat eaten. Plot 7. Very few slugs, less than on 1 or 4. Plots 8-9. Few small slugs, about same as plot 2. Plot 10. Practically no slugs, cleaner than any of the preceding plots. Plots 11-12. About the same as plot 5, rather less slugs, if anything.

August 2 all sprayed.

August 5. Plot 1. Very few slugs, a few old bugs, tops not eaten. Plot 2. No small slugs, a few large ones, tops eaten more than on 1. Plot 3. About the same as plot 2, perhaps not eaten so much nor quite so many slugs. Plot 4. Practically no bugs or slugs, tops very little eaten. Plot 5. Practically as plot 4 as regards bugs, the tops appeared larger than the preceding plots. Plot 6. About the same as 3, not as free from bugs and slugs as 4 and 5, eaten rather more than 4 or 5, tops fully as large as on plot 5. Plot 7. About as plot 4 but not so much eaten. Plot 8. Slugs and bugs as on plot 2, perhaps tops not quite so much eaten. Plot 9. Rather better than 6, less bugs and less eaten than on plot 6. Plot 10. Cleanest from bugs and less signs of their work than on any of the plots 1 to 9. Plot 11. Very clean, but not quite so free from bugs as 10 and more traces of their work than on plot 10. Plot 12. Not quite so free from bugs as plot 11 and more eaten. Plots 1 to 12, for all practical purposes, are very free from bugs, a few leaves on occasional plants had been eaten to a small extent. No plants on the whole piece damaged enough to have any probable effect on yield.

August 27 some blight on all of the plots, leaves yellowed on some plots. Occasional spots on some green leaves. No perceptible difference between the plots of each different kind of insecticide that was used. The general appearance of the crop is too light color to the tops. It is more marked on some rows and especially on the plots near the north side of the field. Some rows are much more affected than others. There is no bloom to be seen on the entire field at a distance. An occasional plant is in the last stage of flowering. The Bug Death was used on plots 2, 5, 8, 11, but no insecticides on the other plots.

September 2, blight on unsprayed fields has made much progress in the past week. Vines with stalks and leaves green a week ago have only the stems left. On Mr. Watson's fields, which had not been sprayed for four weeks, the disease had progressed considerably. The experimental plots are about the same as a week ago, still green with some blight. No noticeable difference between different plots.

September 11. Blight has made a good deal of progress. A few plants died on all the plots; many plants still as green as ever and most of the plants are quite green. No perceptible difference between the different plots. The plots were harvested October 8, 9 and 10. The tops were all dead, having been killed by frost about the middle of September.

PARIS GREEN, BUG DEATH AND ARSENATE OF LEAD COMPARED.

Kind and amount of insecticide, the weighed yield of potatoes, and the starch content of the merchantable potatoes. Bordeaux mixture was used five times on each plot.

Plot number.	Insecticides Used, Kind.	Amount per acre.	Yield of Potatoes Per Acre.				Starch.
			Merchantable.	Small.	Rotten.*	Total.	
		lbs.	bush	bush	bush	bush	per ct.
1	Paris green	21	295	36	32	363	21.28
2	Bug Death	60	315	34	23	372	21.28
3	Arsenate of Lead.	4	285	27	25	337	21.41
4	Paris green	12	305	28	40	373	21.41
5	Bug Death	125	290	34	35	359	22.06
6	Arsenate of lead	24	295	29	80†	404	18.84
7	Paris green	4	285	25	58†	368	19.50
8	Bug Death	75	320	23	55†	398	18.46
9	Arsenate of lead	8	320	27	50†	397	19.19
10	Paris green	8	370	34	28	432	19.46
11	Bug Death.	100	350	25	35	410	18.25
12	Arsenate of lead	16	365	26	41	432	18.87
	Average Paris green		314	31	42	384	20.41
	Average Bug Death		319	29	37	385	20.01
	Average Arsenate of lead.		318	27	49	393	19.58

*There was no soft rot. This includes all discolored potatoes.

† Depression on part of the field with more rot where the soil was wetter.

SUMMARY OF RESULTS OF THIS EXPERIMENT.

At no time during growth were there perceptible difference in color, size or vigor of the vines treated with different insecticides. All these insecticides kept their respective plots sufficiently free from insects to prevent damage; the smaller amounts of the insecticides were nearly as effective as the larger. The poisons were applied early so that the vines were protected before the bugs appeared. Paris green kept the vines a little freer than Bug Death, and Bug Death acted quicker than arsenate of lead, but all three were effective from the practical standpoint.

The yield was smaller on the northern side and increased gradually towards the southern side. The yields were fairly uniform on adjoining plots and the average of the results showed practically no differences in the yield from the plots treated with different insecticides. The loss due to rot was something less than 10 per cent of the total yield on most plots. Because of depressions on plots 6-9, the soil was not as well drained and the rot was increased to about 15 per cent.

The potatoes all had a high starch content, with but little differences. There was no apparent relation between the starch content and the kind of insecticide used. In general the plots having the largest yield had the largest potatoes and the lowest starch content.

The potatoes from plots which were treated with Paris green at the rate of 8 and 12 pounds per acre and arsenate of lead at the rate of 16 and 24 pounds were tested for arsenic and were found to be entirely free.

EXPERIMENTS BY MR. ROGERS OF BRUNSWICK.

Two experiments comparing Paris green, Bug Death and arsenate of lead were made in 1902 by Mr. E. A. Rogers of Brunswick. One of these experiments was conducted at Brunswick and the other was made for the Danforth Chemical Company in Caribou. Mr. Rogers furnished the Station the full report of these experiments, but as they have been printed in detail in the Maine Farmer only a summary is here given of the experiments and Mr. Rogers' conclusions.

TABLE SHOWING PLAN AND YIELD PER ACRE IN EXPERIMENT AT BRUNSWICK.

Plots.	Insecticides Used, Kind.	Lbs. per acre.	Yield per Acre in Bushels.			
			Marketable—large.	Rotten.	Small.	Total.
2	Bug Death	125	415	11	16	442
3	Arsenate of lead	15	358½	4	18½	381
4	Paris green	7½	354	8	22½	384½
5	Bug Death	125	369	5	15½	389½
6	Arsenate of lead	15	328	7	20½	355½
7	Paris green	7½	330½	¼	18½	349¼
8	Bug Death	125	362	⅛	20½	382⅝
9	Arsenate of lead	15	320	1½	23¼	344¾
10	Paris green	7½	279	1½	18½	299
	Average marketable.	Bush.				
	Bug Death	382				
	Arsenate of lead	335½				
	Paris green	321⅙				

TABLE SHOWING PLAN AND YIELD PER ACRE IN EXPERIMENT AT CARIBOU.

Plot number.	Insecticides Used, Kind.	Pounds.	Yield per acre in bushels.		Total.
			Marketable.	Small and rotten.	
1	Bug Death	100	279	66	345
2	Paris green	4	247	74	321
3	Bug Death	100	282	77	359
4	Arsenate of lead	8	245	78	323
5	Bug death	100	303	53	356
		Bush.			
	Total average yield per acre for Bug Death	353⅓			
	Total av. (Plot 2) yield per acre for Paris green	321			
	Total av. (Plot 4) yield per acre for arsenate of lead	323			

In both of the experiments conducted by Mr. Rogers the yields were considerably larger on the Bug Death plots than on the Paris green or arsenate of lead plots. From the experiments at Brunswick and Caribou Mr. Rogers draws the conclusion that Bug Death was much the best insecticide used; that it did its work much better and cleaner than either Paris green or arsenate of lead; that Bug Death preserves the life of the vines and that the increased yield from the use of Bug Death would more than pay its cost.

In the Station experiments at Houlton, Paris green was the most efficacious of the three insecticides used, although Bug Death at the rate of 15 pounds and arsenate of lead at the rate of 2 pounds to the acre in each application were efficacious for all practical purposes. There was no difference in the appearance of the vines due to the different insecticides during the growth, nor in the yield of potatoes. One desiring to use an insecticide for plants free from arsenic will, according to our experience, find Bug Death satisfactory when applied in sufficient quantities. Bug Death can be readily applied with Bordeaux mixture up to 40 pounds to the barrel. According to our experience, 15 pounds per acre at each application is nearly as effective as a larger amount.

OAT SMUT AND ITS PREVENTION.

CHAS. D. WOODS.

Farmers' Bulletin No. 75 of the U. S. Department of Agriculture describes the grain smuts and explains how they may be prevented. This bulletin may be obtained by addressing the Secretary of Agriculture, Washington, D. C., from your Congressman or from the Maine Experiment Station.

The following, selected from the "summary" of bulletin 75, outlines the disease, its cause and its prevention:

Smuts of cereals are caused by minute parasitic fungi, the spores or seed-like bodies of which form the black, dusty mass which takes the place of the kernels or the entire head.

The spores are very minute and are easily blown about, often adhering to the kernel before it is planted. When such kernels sprout, the spores also germinate and send delicate threads into the young seedlings. These threads follow the growth of the plant, fill the head as soon as formed, and there develop a mass of spores instead of kernels.

Loose smut of wheat attacks the whole head and converts it into a mass of loose, dusty spores. It causes considerable damage in some localities and is more difficult to prevent than other smuts.

Loose smut of oats is very similar to loose smut of wheat and probably causes an annual loss in the United States of more than $18,000,000.

Barley is attacked by two smuts and rye by one. Corn smut is widespread, but fortunately it usually causes only very slight loss. As yet no effective remedy is known for corn smut.

The formalin treatment has been found very effective in preventing stinking smuts of wheat and oat smut. It consists in soaking the seed for two hours in a solution of 1 pound of formalin to 50 to 60 gallons of water. The strong formalin is poisonous, and great care should be exercised in its use. [For a full description of how to use the formalin see page 211.]

The stinking smuts of wheat and oat smut can also be prevented by treating the seed with hot water at 132° for ten minutes.

Loose smut of wheat and barley smuts can be prevented by soaking the seed in cold water for four hours, allowing it to stand four hours more in wet sacks, and then treating for five minutes in water at 132°.

The potassium-sulphide treatment is thoroughly effective for loose smut of oats. It consists in soaking, say, 3 bushels of seed for twenty-four hours in a solution of 1½ pounds of potassium sulphide to 25 gallons of water. Liver of sulphur should be used and the solution should be kept in a tightly closed vessel to protect it from the air.

To dry the grain after any of the treatments described, spread it on a clean floor, or on canvas sheets spread in the sun, preferably on a raised lattice work, say, 2 or 3 inches deep, and turn it over at least twice a day.

In treating oats for smut by either potassium sulphide or hot water an increase in yield is obtained beyond and above the amount that would result from replacing the smutted heads with sound ones. The increase in yield from seed treatment is usually two or three times as much as the apparent loss from smut in untreated fields.

The Wisconsin Experiment Station* found oats smut very prevalent in that state and estimated the loss from this disease in 1901 to have exceeded six million dollars. They have successfully experimented with formaldehyde with the following results.

SUMMARY OF EXPERIMENTS AT WISCONSIN STATION.

Seed oats submerged for	In a solution	Smut found.
Twenty minutes	1 lb. formaldehyde to 50 gal. water	0.0 per ct.
Sixty minutes	1 lb. formaldehyde to 200 gal. water	20.0 per ct.
Ten minutes	1 lb. formaldehyde to 50 gal. water	1.0 per ct.
Forty minutes	1 lb. formaldehyde to 100 gal. water	4.3 per ct.
Twenty minutes	1 lb. formaldehyde to 100 gal. water	5.0 per ct.
Not treated		

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* Bulletin 91 Wisconsin Experiment Station.

HOW TO TREAT SEED OATS TO PREVENT SMUT.

As the result of field experiments the Wisconsin Station recommends the following:

"If 50 bushels of seed oats are to be treated, secure from a drug store one pound or a pint of formaldehyde (sometimes called formalin.) Speak to your druggist in advance so that he may secure the formaldehyde in time, if he does not have it on hand. Put into a barrel or cask 50 gallons of water and pour in the one pound of formaldehyde liquid to make the proper solution. Dip out about one-half of the solution into another cask in order to treat two sacks of oats at the same time, thus facilitating the work. Place about two bushels of oats in each of two gunny sacks or large bags and submerge the oats in the solution for twenty minutes; then lift the sacks from the casks and let drain for a minute or two so as to save the solution. Empty the oats on a threshing floor or on a canvas to dry and proceed as before, using the same sacks for the remainder of the oats."

"The solution as used is not poisonous and will not injure the sacks or clothing coming in contact with it. Formaldehyde is a gas generated by burning wood alcohol. It is readily soluble in water, which will hold 40 per cent of it in solution. This solution is sold by most drug stores under the name of formaldehyde or formalin at about 50 cents per pound."

"It is well to treat the seed oats two or three days before sowing to give ample time to dry. If the oats are shoveled over a few times it will facilitate the drying very much and no difficulty will be experienced sowing with seeder or drill. The treated oats can be sown with a force-feed drill or seeder when quite damp, but the machine should be set so that it will indicate sowing about a peck more than the quantity desired per acre, as the oats are swollen and will not run quite as freely as dry oats."

"The treatment of seed oats seems to facilitate the sprouting; a difference of from two to four days in favor of the oats treated will be noticeable."